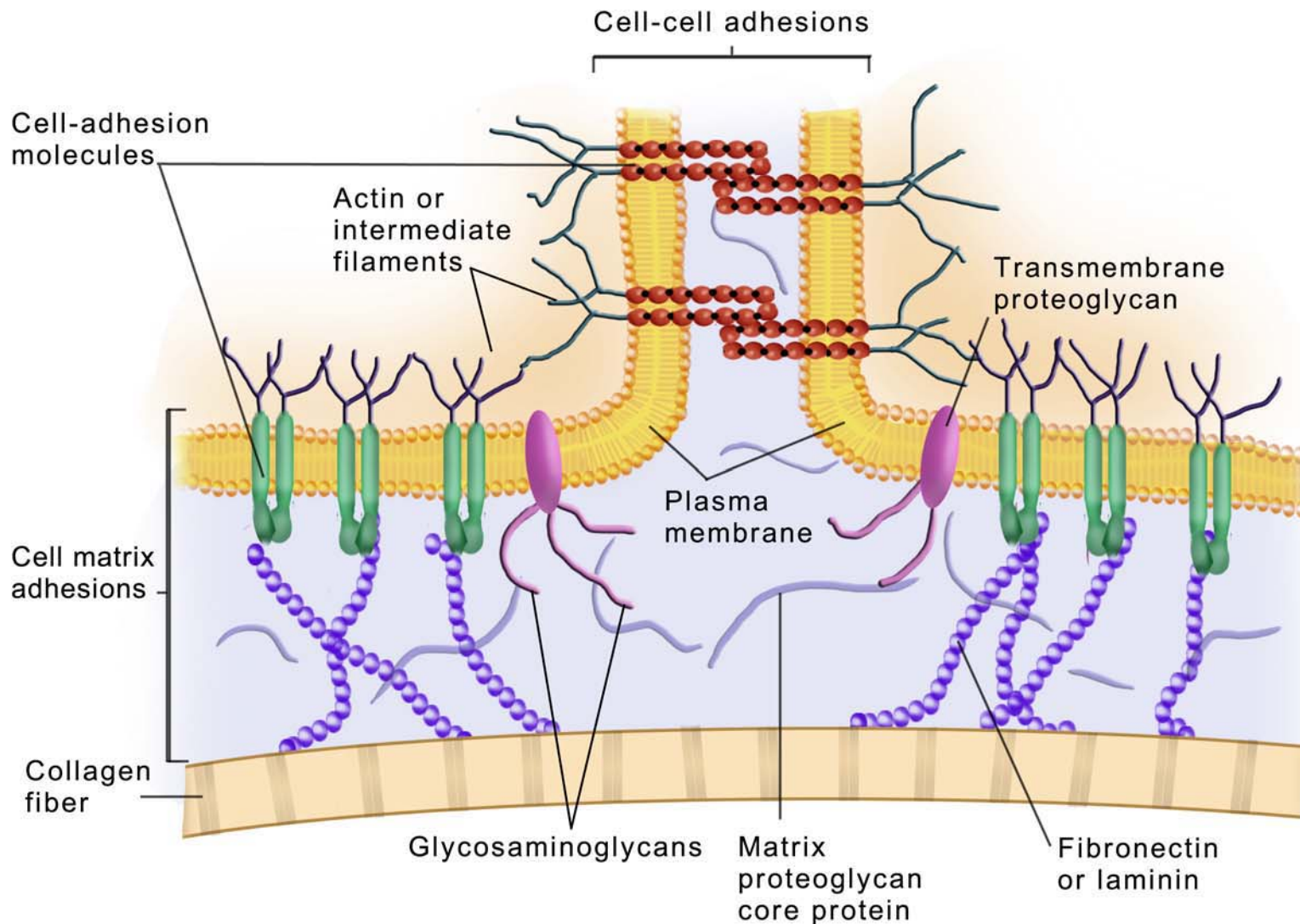


Cell Adhesion

- Structural Integrity
- External Sensing
- Migration
- Regulation of Transport
- Communication

Lodish Chapter 22
Kamm Chapter 2

Overview of the types of molecules that bind cells to each other and to the extracellular matrix



Cell adhesion molecules and their characteristics

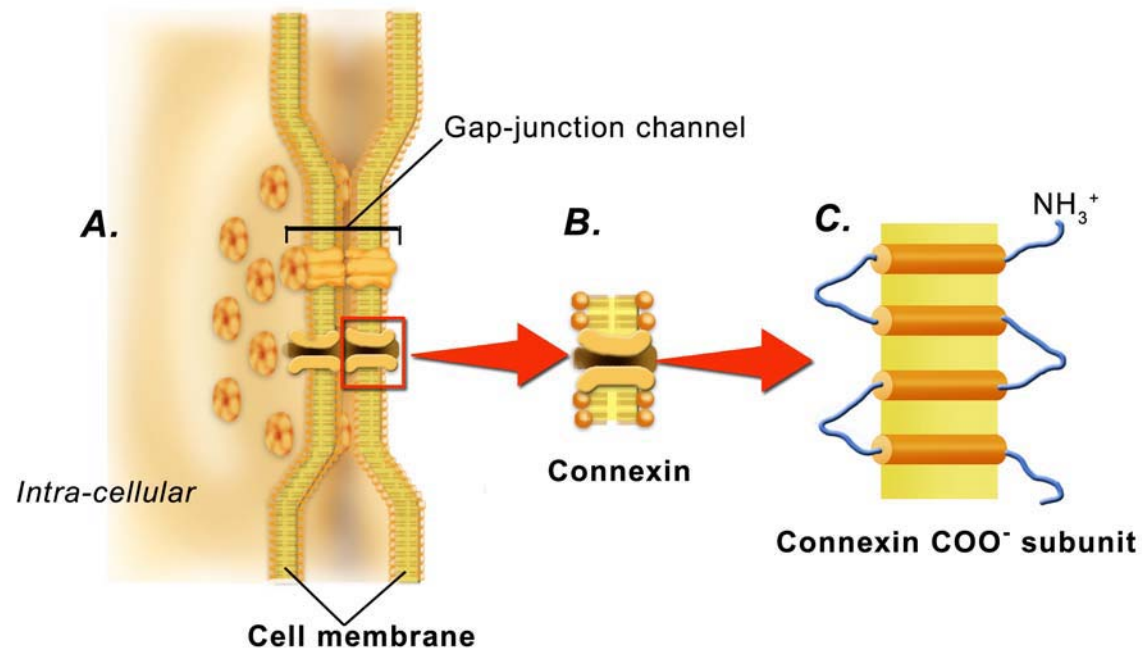
Family	Location and/or function	Ligands recognized	Comments
integrins	focal adhesions, hemi-desmosomes, leukocyte ("spreading") adhesion, primarily cell-matrix adhesion but also in some cell-cell adhesions	(E) fibronectin, collagen, laminin, immunoglobulins, (I) actin filaments	relatively low affinities ($K_D \sim 10^{-6}$ - 10^{-8} mol/liter)
selectins	circulating cells and endothelial cells, "rolling" adhesion	carbohydrates	require Ca^{2+}
Ig superfamily (immunoglobulin) cadherens	important in immune response adherens junctions, desmosomes	integrins, homophillic (E) homophillic, (I) actin filaments, intermediate filaments	require Ca^{2+}

Adhesion complexes

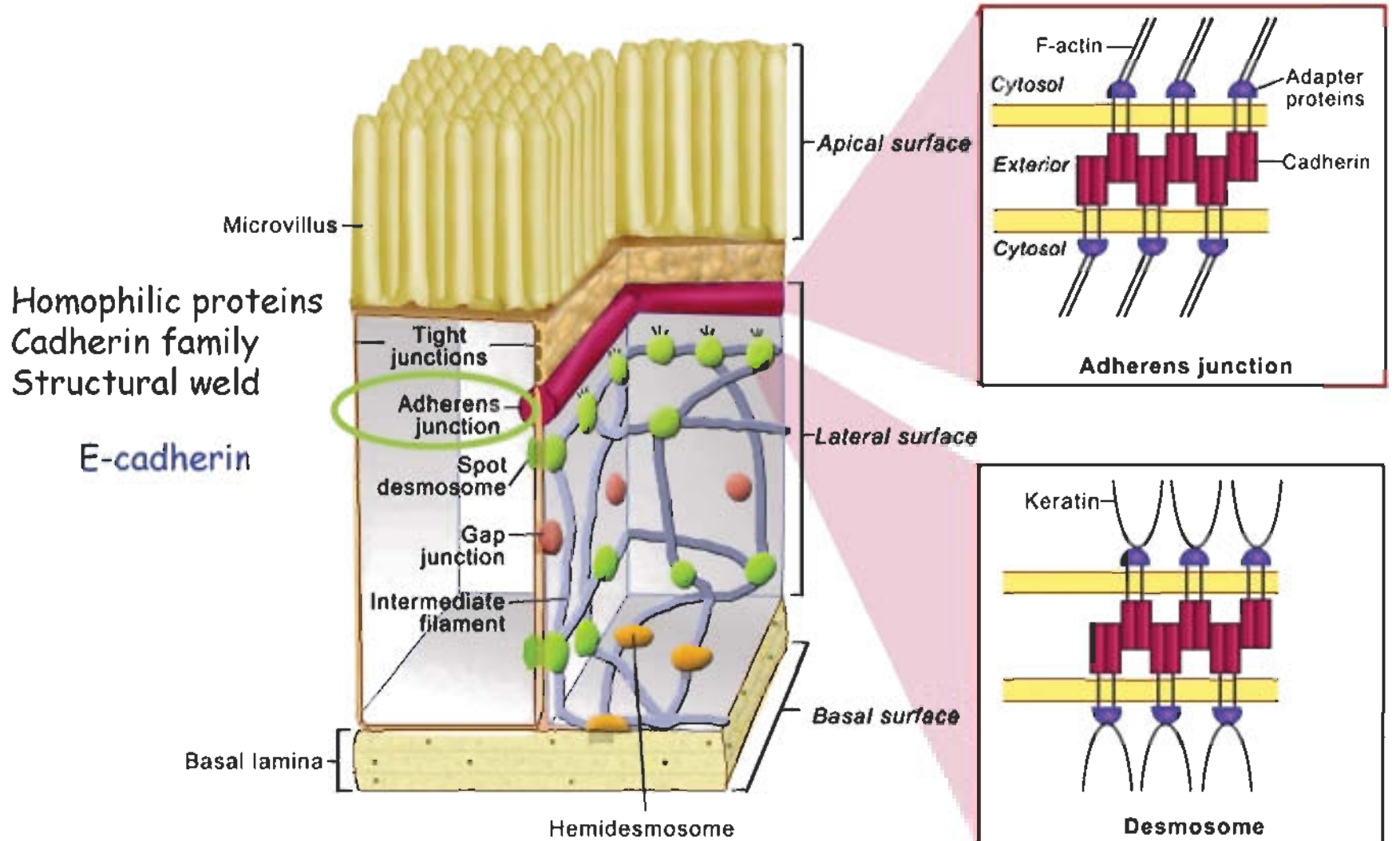
Junction type	Function	Extracellular or adjacent cell attachment	Intracellular attachment
Adherens	structural, cell-cell or cell-matrix	ECM proteins or cadherins in adjacent cell	actin filaments
Desmosome	structural, cell-cell	cadherin	intermediate filaments
Hemidesmosome	structural, cell-matrix	basal lamina via integrins	intermediate filaments
Focal adhesions	structural, cell-matrix	ECM proteins via integrins	actin filaments
Tight junction	regulate transport between cells and along cell membrane		
Gap junctions	cell-cell communication via ion and small molecule exchange	channels formed by connexin subunits	

Table 2. Adhesion complexes.

Gap junctions allow small molecules to pass between adjacent cells



Adherens junctions in epithelial cell



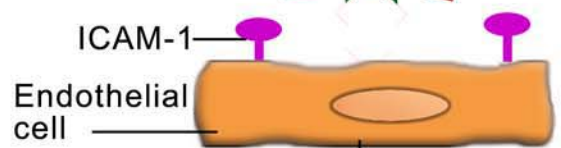
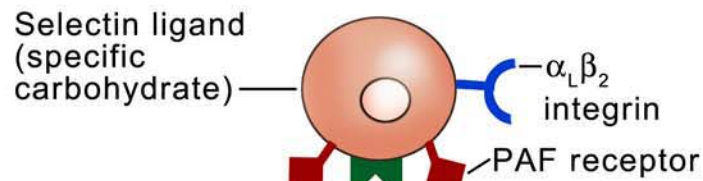
Desmosomes: "spot welds"

Image removed due to copyright considerations.

See Orsello, C.E., D. A. Lauffenburger and D. A. Hammer. "Molecular properties in cell adhesion: a physical and engineering perspective." *TRENDS in Biotechnology*, Vol. 19 No. 8 (August 2001).

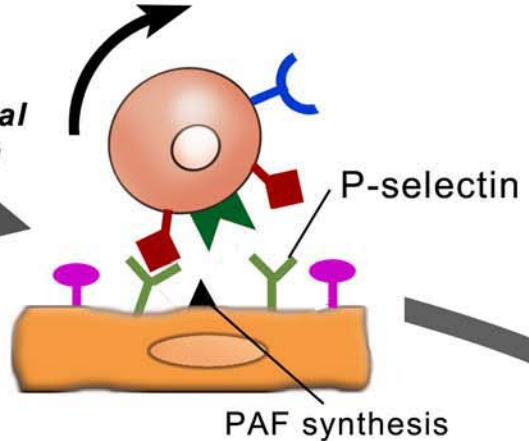
Selectins and other CAMs participate in leukocyte extravasation

1. Free leukocyte

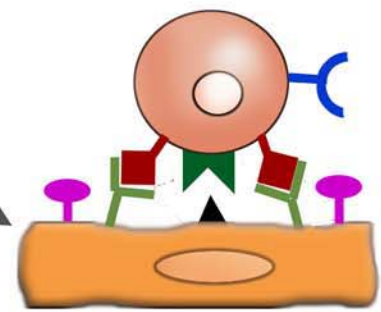


Endothelial activation

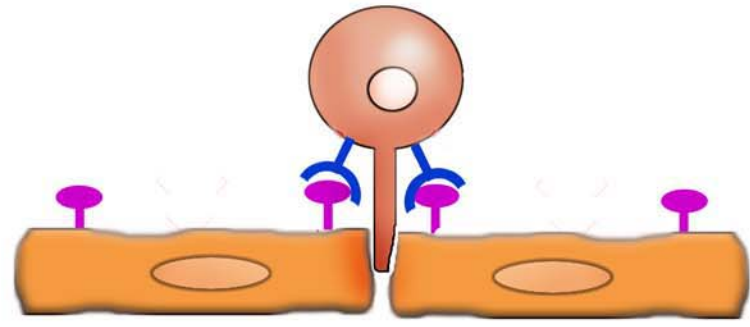
2. Transient rolling leukocyte



3. Leukocyte activation, rolling and firm adhesion (PAF activates integrin)



Leukocyte adhesion (integrin bonds to ICAM-1)



4. Extravasation

Integrins mediate weak cell-matrix and cell-cell interactions

Image removed due to copyright considerations.

See [Lodish] Table 22-2.

PubMed URL: <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mcb.table.6528>

Cell-matrix adhesion is modulated by changes in the activity and number of integrins

De-adhesion factors promote cell migration and can remodel the cell surface

Integrin-containing junctions connect cells to the substratum

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See [Lodish] Figure 22-9.

PubMed URL: <http://www.ncbi.nlm.nih.gov/books/bv.fcgi?rid=mcb.figgrp.6533>

Integrin-containing junctions connect cells to the substratum

Focal adhesions: clusters of receptors

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See [Lodish] Figure 22-10.
PubMed does not have this image.

Figure 22-10

Comparison to JKR theory for adhesion

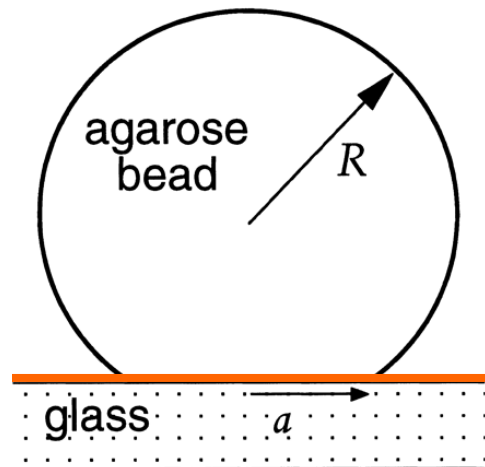


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Ligand-receptor system:
iminobiotin- avidin

Moy et al. Biophys J. 1999

Images removed due to copyright considerations.

See Fig. 5 and Table 2 in Chen, Shuqi and Timothy A. Springer. "Selectin receptor-ligand bonds: Formation limited by shear rate and dissociation governed by the Bell model." PNAS v98(3): 950-5 (Jan 30 2001).

Images removed due to copyright considerations.

See Fig. 1, Fig. 3 and Table 1 in Chang, Kai-Chien, David F. J. Tees, and Daniel A. Hammer. "The state diagram for cell adhesion under flow: Leukocyte rolling and firm adhesion." PNAS v97(21): 11262 (Oct. 10, 2000).